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Guided-discovery Learning Strategy and Senior School Students Performance in Mathematics in Ejigbo, Nigeria

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Abstract
The concern of this study was to investigate the effect of guided-discovery learning strategy on students performance in Mathematics alongside influence of gender and scoring levels ability of the students. 202 SSI Students from two selected public co-educational schools in Ejigbo Local Government Area of Osun State constituted the sample of the study. The research was a quasi-experimental one and the main instrument for data collection was a 20-item multiple choice Mathematics Achievement Test drawn from West African Examination Council past questions on Set Theory. Three research questions was raised with three corresponding hypotheses tested. Results revealed a significant difference in favour of those exposed to guided-discovery learning strategy compared to those not taught using guided-discovery learning strategy. Though both male and female students performed equally well when taught using guided discovery strategy, the study showed that high scoring students benefited most while the performance of low scoring students was also enhanced. It was recommended among others that mathematics teachers should make the teaching-learning of mathematics an interactive and activity – based one for the students using strategy that all students could gain from irrespective of the ability levels of the students and, government both at Federal and State levels should periodically asides regular workshops for teachers develop a mean of reviewing / assessing the impact of teaching strategies.
Key words: Guided-discovery, learning, strategy, students, performance, Mathematics

1.Introduction

Mathematics is the language without which science, commerce, industry, the internet, and the entire global economic infrastructure are struck dumb. Mathematics is regarded as pillar of almost all the streams in academics given its importance in tertiary education and most careers. It is not only beneficial but also essential. Hence, Mathematics is not only a language and a subject in itself, but it is also critical in fostering logical and rigorous thinking; as such its influence is immense.

Aminu (1990) argued that mathematics is not only the language of sciences, but essential nutrient for thought, logical reasoning and progress. Mathematics liberates the mind and also gives individuals an assessment of the intellectual abilities by pointing towards direction of improvement. He concluded by saying that mathematics is the basis of all sciences and technology which application cut across all areas of human knowledge.

The essence of Mathematics therefore lies in its beauty and its intellectual challenge. Both scientific breakthrough and technological development are facilitated by the precise language of Mathematics. This implies that there exists a strong link between progress in mathematics and technological advancement. Thus, every man requires a certain amount of competence in basic topics in mathematics for the purposes of handling money, prosecuting daily businesses, interpreting mathematical graphs and charts as well as thinking logically. (Bandura, 1997). In spite of all these, the subject is still seen as a difficult one and has generated phobia among learners. The differential scholastic achievement of students in Nigeria has been and is still a source of concern and research interest to educators, government and parents. This is so because of the great importance it has on the national development of the country. All over the country, there is a consensus of opinion about the fallen standard of education in Nigeria (Adebule, 2004). Parents and government are in total agreement that their huge investment on education is not yielding the desired dividend. Teachers also complain of students' low performance at both internal and external examinations. The annual releases of Senior Secondary Certificate Examination results (SSCE) conducted by West African Examinations Council (WAEC) justified the problematic nature and generalization of poor secondary school students' performance in different school subjects. A wealth of research reported that students blamed their poor performance on three broad areas: teaching problems, negative attitudes of students towards the subject, and examination difficulty. The degree of blame on these areas as reported is given as teaching problems / method, 67%; negative attitude, 42% and examination difficulties, 21%. This agrees with the study of Fajemidagba (1986) who had earlier identified problems of mathematics learning as students' perception of same to be highly theoretical and meaningless to everyday activities. He also observed that teachers adopt poor methods in the teaching of mathematics in schools, and that high percentage of the relatively small number of the available textbooks does not reflect the culture of the Nigerian children. He submitted further that mathematics teachers often say mathematics is useful but failed to show its usefulness. Hence, most students could not see reason for studying mathematics (Fajemidagba, 1999).

Further to this, Aremu and Sokan (2003) submit that the search for the causations of poor academic achievement in mathematics is unending but some of the major factors they put forward are: methods of teaching, self-esteem / self efficacy, study habits, teacher consultation and poor interpersonal relationships. The foregoing seems to make it increasingly a source of concern considering the fact that mathematics plays a vital role in scientific, technological and social progress of any nation and indeed all works of life. The debate on appropriate teaching strategy is inclusive and widely open to further investigation. Consequently, the question emerges again, does learning strategy affects students performance in mathematics?

This study investigated the effect of guided-discovery learning strategy on students performance in mathematics. The study also examined the influence of gender and scoring level on students performance in mathematics.

1.1 Research Questions

The following research questions were raised in the study.

1. What is the difference between the mean gain scores of students in mathematics taught using guided–discovery learning strategy and non guided-discovery learning strategy?
2. What is the influence of gender on senior school students performance in mathematics when taught using guided-discovery learning strategy?
3. Is there any difference in the senior school students performance in mathematics on the basis of their scoring levels when taught using guided –discovery learning strategy?
4. Is there any interaction effect between the treatment and gender on the performance of students in mathematics?
5. Is there any interaction effect between the treatment and the students' scoring levels on the performance of students in mathematics?

1.1.2 Research Hypotheses

The following null hypotheses were tested in this study:

HO_1: There would be no significant difference in mean gain scores of the senior school students taught using guided-discovery learning strategy in mathematics and those taught using non guided-discovery learning strategy.

HO_2: There would be no significant difference in the mean gain scores of male and female students in mathematics when they are taught using guided-discovery learning strategy.

HO_3: There would be no significant difference in mean gain scores of students with high, medium and low scoring level when they are taught using guided-discovery learning strategy.

HO_4: There would be no significant interaction between the treatment and gender on the performance of students in mathematics.

HO_5: There would be no significant interaction effect between the treatment and students' scoring levels on the performance of students in mathematics.

2.0 Research Methodology

This study was a quasi-experimental research designed to determine the effects of guided-discovery learning strategy as predictor of learners' achievement in mathematics. The pre-test and post-test control group design was considered appropriate for this study. The pre-test, post-test of 2 x 2 x 3 experimental design was employed. The experimental levels are as follows: Strategies of teaching-learning at 2 levels (guided-discovery and non guided-discovery), Gender at 2 levels (male and female) and the scoring levels which is at 3 levels (high, medium and low scorers). 202 students from two purposively selected Senior Secondary School I in Ejigbo Local Government Area of Osun State offering Mathematics participated in the study. The schools were labeled A and B with school A used as experimental and B as the control group respectively.

2.1 Research Instrument

The main instrument that was used for data collection was a 20-item multiple choice Mathematics Achievement Test (MAT) on the concept of Set theory drawn from the past West Africa Senior School Certificate Mathematics Examinations questions. Minimum and maximum scores of 0 and 20 were expected respectively to be the range within which the performance of both groups should fall (0-6 categorized as low scoring, 7-13 categorized as medium scoring and 14-20 as High scoring students). For reliability purpose, the test was administered to an intact class of two non-participating schools. After two (2) weeks, the same test was re-administered to same set of students. Their scores were correlated using Pearson's Product Moment Correlation Coefficient Method and a coefficient of 0.69 was obtained.

The instructional instruments were lesson plans drawn on guided-discovery learning strategy and non guided-discovery strategy in teaching the experimental and control group respectively. The guided-discovery learning strategy was student–activity centred which required a lot of interaction among the researcher, students

and instructional materials. The control group was taught using the non guided-discovery mode only, that is, the group was exposed only to lecture method. Instructions were highly verbalized with minimum interaction between students and instructional materials. The researcher assisted by the research assistant personally taught the experimental group while the regular mathematics teacher assisted in teaching the control group.

Two periods of forty (40) minutes was spent each week throughout the treatment period. The study lasted for six (6) weeks of three (3) weeks teaching while first, second and the last week were used for preparation, pre-test and post-testing respectively.

3.0 Results

Hypotheses one and two were tested with independent (uncorrelated) sample t-test statistics while hypotheses three, four and five were tested using Analysis of Covariance (ANCOVA). Hypotheses one and two involved comparison of two variables (experimental and control; males and females) respectively. Hypotheses three involved the comparison of more than two variables: low, medium and high scoring students while hypotheses four and five involved the determination of interaction effects. This is in agreement with Fajemidagba (1995) who stated that ANCOVA is the appropriate statistic to use when testing hypothesis where effects of more than two independent variables are to be determined.

HO_1: There would be no significant difference in post-test mean scores of the senior school students taught using guided-discovery learning strategy in mathematics and those taught using non guided-discovery learning strategy.

Table 1 reveals that the calculated t-value =9.389 with p-value of .000 < 0.05 alpha level. Since the p-value is lesser than the alpha level of 0.05, the null hypothesis one was rejected and the alternative hypothesis that, there would be a significant difference in post-test mean scores of students taught using guided –discovery learning strategy and those taught without the use of guided-discovery learning strategy was upheld. To ascertain where the significant difference lies, the mean scores of the two groups were compared. The mean scores of the guided-discovery learning strategy (14.0667) is greater than the mean scores (10.7143) of the non guided-discovery learning strategy. Thus, it is in favour of guided-discovery learning.

HO_2: There would be no significant difference in the post-test mean scores of male and female students in mathematics when they are taught using guided-discovery learning strategy.

From Table 2, analysis reveals that the calculated t-value = .168 with p-value of .867 > 0.05 alpha level. It implies that the null hypothesis three which state that there would be no significant difference in posttest mean scores of male and female students in mathematics when they are taught using guided-discovery learning strategy was accepted . In other words, the performance of male and female students taught using guided discovery learning strategy shows no difference. Hence, the hypothesis is upheld.

HO_3: There would be no significant difference in post-test mean scores of students with high, medium and low scoring level when they are taught using guided-discovery learning strategy.

Table 3 indicates the Analysis of Covariance containing the scoring ability levels, mean squares, fvalue and the corresponding p-values. From the table, the calculated f-value is 8.413 with p-value equals .000which is less than the alpha level of 0.05. This implies that the null hypothesis three is rejected and the alternative hypothesis which states that there would be a significant difference in post-test mean scores of students with high, medium and low scoring level when they are taught using guided-discovery learning strategy is upheld. To further ascertain this with respect to where the difference lies, Duncan post-hoc test was carried out and the output is shown in table 4. From table 4, 15.1818 in subset 3 reveals that students with high scoring ability is most significant of all the groups. It is followed by students with average scoring ability in subset 2 with 13,1765. The least is, low scorers with 9.6667 in subset 1.

HO_4: There would be no significant interaction between the treatment and gender on the performance of students in mathematics.

From table 5, there was no significant interaction effect between the treatment and students' gender. This was because at $F(1, 197) = .002$, $p > 0.05$ therefore, the null hypothesis was accepted. This is further corroborated in the profile plot as shown in figure 1 where the two lines appeared too close indicating that, there was no major difference even in the treatment condition.

HO_5: There would be no significant interaction effect between the treatment and students' scoring levels on the performance of students in mathematics.

Table 6 showed that the computed value of $F(1,196) = .171$, $p < 0.05$, the null hypothesis was rejected. Therefore, there was a significant interaction between the scoring levels of the students and the treatment. Figure 2 also revealed the difference that existed in the treatment condition.

4.0 Summary of Findings

The following are the summary of major findings in this study:

1.the experimental group taught using guided-discovery learning strategy had a significantly higher score than the control group taught using the non guided discovery;

2. post test mean scores of male students was not significantly higher than that of the female students when taught using guided-discovery learning strategy; and

3.Higher scorers benefited most, followed by medium scorers and the low scorers benefitted least when taught using guided-discovery learning strategy. To further ascertain this with respect to where the difference lied, Duncan post-hoc test was carried out and the output of 15.1818 in table 8 subset 3 reveals that students with high scoring ability is most significant of all the groups.

4. there was no significant interaction effect between the treatment and students' gender. This was because at $F(1, 197) = .002$, $p > 0.05$.

5.there was a significant interaction between the scoring levels of the students and the treatment, $F(1,196) = .171$, $p < 0.05$.

4.1 Discussion

The central focus of this study was to investigate the effects of guided discovery learning strategy on students' performance in Mathematics and the findings from the t-test of the post-test mean scores of hypothesis one revealed that all of the experimental group students exposed to guided-discovery learning strategy performed significantly better than the control group students exposed to non-guided strategy. The finding of this study agrees with those of Martins and Oyebanji's (2000) and Bajah and Asim (2002) where they found that guided discovery approach was more effective than the conventional or any other methods on students' acquisition of knowledge in teaching-learning process. The study however showed that both male and female students benefitted equally when exposed to guided discovery strategy of learning. Therefore, gender had no effect on the performance of the students in Sets theory problems using guided discovery learning strategy. This is similar to Salman (1998) and Suleiman (2010) findings in related studies where they found out that gender had no effect on students academic performance in Mathematics word problem using Ausubel pre-instructional strategy and three problem solving models of Polya, Brainford and Stein and Gicks respectively.

The result in tables 3 and 4 based on treatment inferred from hypothesis three revealed that the low scorers benefitted least when taught using guided-discovery learning strategy . However, it benefited high scorers most. The finding of this study agrees with those of Aiyedun (1995), Yusuf (2004) and Manklik (2006). They all found that there was a significant difference in the performance of students in different scoring levels.

4.2 Conclusion

Evidence abound in the literatures reviewed which showed that students still performed poorly in Mathematics despite its prominent roles in scientific and technological development of a nation. Factors identified for this include poor teaching method, poor foundation and abstract nature of mathematics lessons and individual cognitive style. It is against this backdrop that the present study was carried out with a view to investigating the effects of guided-discovery learning strategy on senior secondary school students performance in mathematics.

Results from this study have shown that there was a significant difference in the performance of Mathematics students taught using guided discovery learning strategy over the students taught using non guided discovery strategy. The study has shown the potency of guided discovery learning strategy in improving student's performance. Equally, findings from the present study have also shown that gender has no role to play in the performance of the students. The findings of this study has also revealed that all scoring ability groups benefited from the strategy of learning with high scoring ability as most significant of all the groups.

This implies that guided discovery learning strategy stimulated the low, medium and high scoring students to better performance separately.

4.3 Recommendations

In line with the findings of this study, the following are recommended:

1. Guided Discovery Learning Strategy was found helpful in learners' ability to extract a simple figure from a complex one since it was more interactive. It is recommended that the teachers should make the teaching-learning of mathematics an interactive and activity – based one for the students. Teachers should use many strategies while teaching mathematics, for instance set theory, so that all students could gain from the teaching irrespective of the ability levels of the students.
2. Male and females should have roles to play in mathematics class since males are not superior to female in mathematics class as found out in this study.
3. Ministries of Education at both Federal and State levels should periodically asides regular workshops for teachers develop a mean of reviewing / assessing the impact of teaching strategies.

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Table 1:

The t-Test Analysis showing difference in post-test mean scores of students taught using guided-discovery learning strategy and those taught without the use of guided-discovery learning strategy

Variables	No	Mean	std	df	t-value	sig
Guided	90	14.0667	2.49404			
				200	9.389	.000
Non-guided	112	10.7143	2.54484			

Table 2:

The t-Test Analysis showing difference in post-test mean scores of male and female students in mathematics when they are taught using guided-discovery learning strategy

Variables	No	Mean	std	df	t-value	sig
Male	46	14.0652	2.58545			
				88	.168	.867
Female	44	13.9767	2.37535			

P < 0.05

Table 3:
ANCOVA Analysis showing difference in the post-test mean scores of students with high, medium and low scoring level when they are taught using guided-discovery learning strategy

Source	Type III Sum of Squares	df	Mean Square	f	Sig.
Corrected Model	97.785[a]	3	32.595	6.150	.001
Intercept	2517.655	1	2517.655	475.013	.000
Pretest	4.006	1	4.006	.756	.387
Scoring Level	89.186	2	44.593	8.413	.000
Error	455.815	86	5.300		
Total	18362.000	90			
Corrected Total	553.600	89			

a. R Squared = .177 (Adjusted R Squared = .148); $p<0.05$

Table 4:
Duncan Post-hoc Test

		Subset for alpha = 0.05		
Scoring Level	N	1	2	3
Low	6	9.6667		
Medium	51		13.1765	
High	33			15.1818
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Table 5:
ANCOVA Computation on Post-test Mean Scores of Students in the Treatment Group and Gender

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	824.707[a]	4	206.177	39.893	.000
Intercept	4535.492	1	4535.492	877.569	.000
Pretest	251.631	1	251.631	48.688	.000
Treatment	372.906	1	372.906	72.153	.000
Gender	.142	1	.142	.027	.869
Treatment * Gender	.011	1	.011	.002	.963
Error	1018.144	197	5.168		
Total	31850.000	202			
Corrected Total	1842.851	201			

a. R Squared = .448 (Adjusted R Squared = .436)

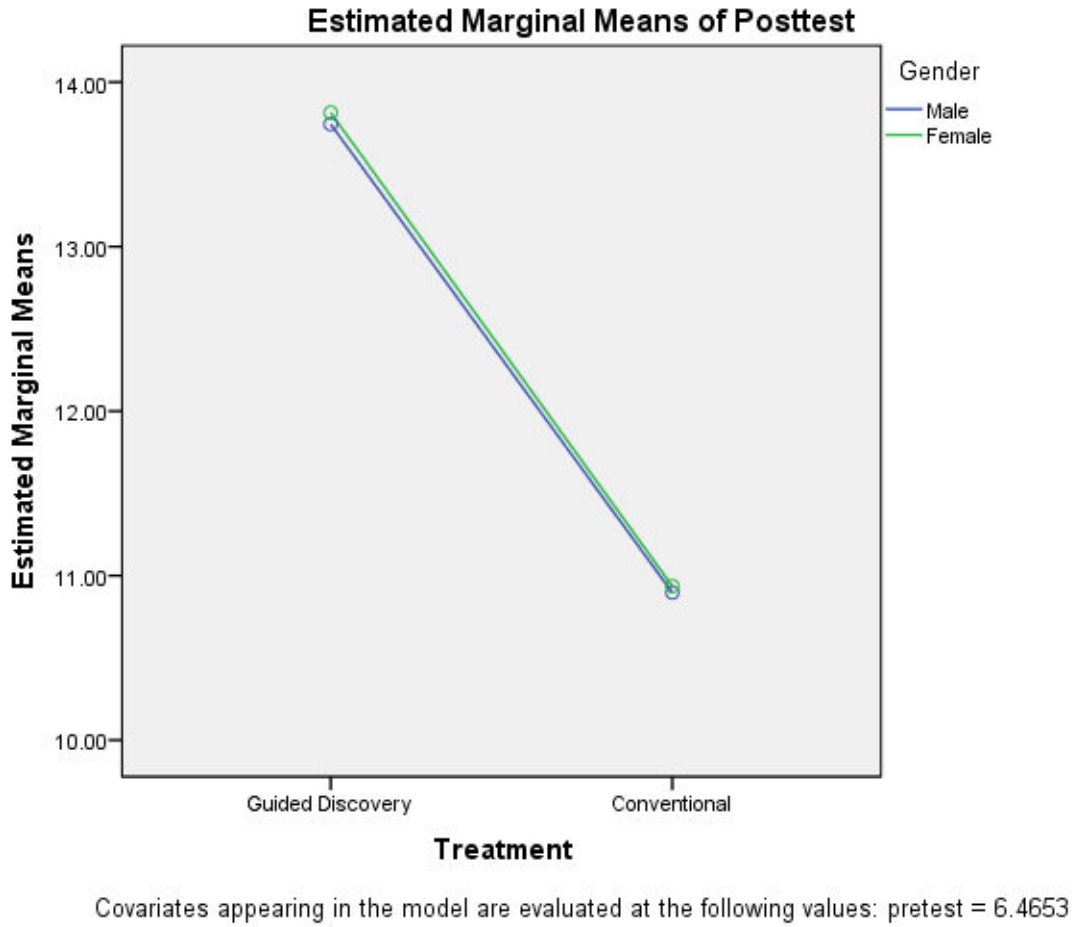

Figure 1: Graph on the interaction effect between the treatment and the students' Gender

Table 6:
ANCOVA Computation on Post-test Mean Scores of Students in the Treatment Group and Scoring levels

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1362.574[a]	5	272.515	111.213	.000
Intercept	3290.016	1	3290.016	1342.647	.000
Pretest	30.681	1	30.681	12.521	.001
Treatment	59.919	1	59.919	24.453	.000
Scoringlevel	453.486	2	226.743	92.533	.000
Treatment * Scoringlevel	.420	1	.420	.171	.679
Error	480.278	196	2.450		
Total	31850.000	202			
Corrected Total	1842.851	201			

a. R Squared = .739 (Adjusted R Squared = .733)

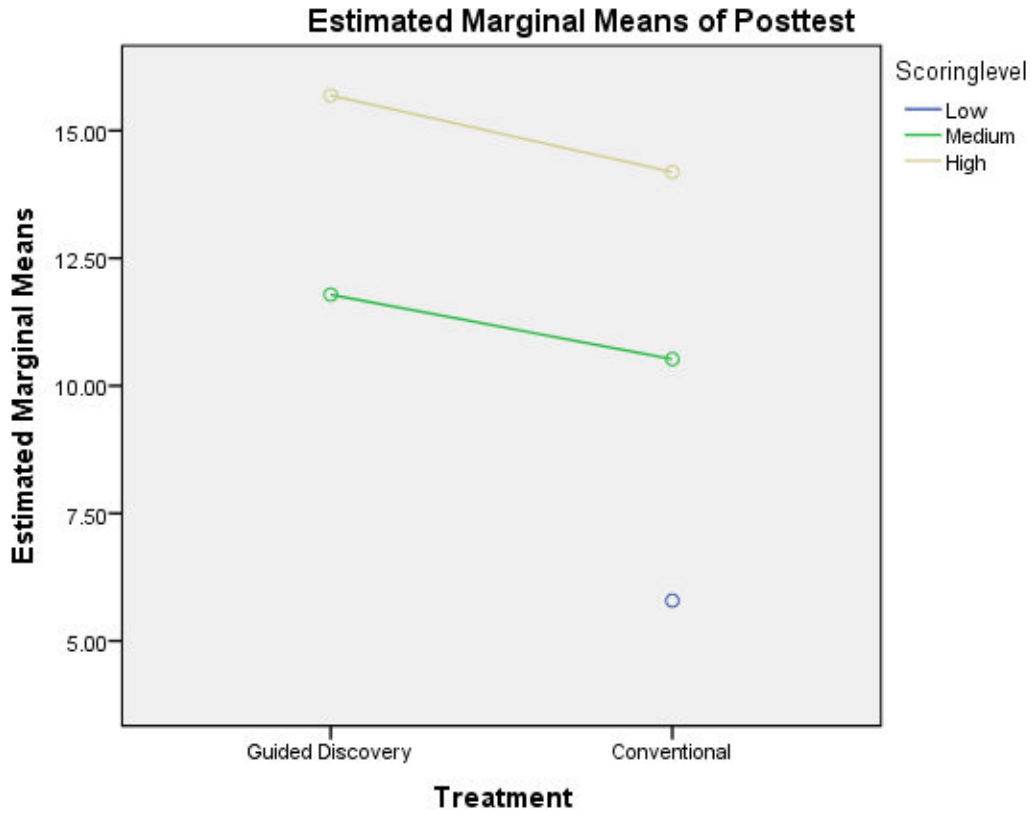

Figure 2: **Graph on the interaction effect between the treatment and the students' Scoring levels**